ENGINEERING

Regional Supervisor, Division of Wildlife Refuges — January 23, 1968

In reply refer to:
EH-R-Tewaukon
Annual Water Program

Regional Engineer

1968 Annual Water Program - Tewaukon NWR

We have reviewed and concur in the proposed program for 1968, subject to the following comments and suggestions.

Stephan 1-23-68

Doeling 1-24-68

JM 1-24

We again wish to compliment the manager and his staff on keeping good water use records and on presenting such a good summary of data. We appreciate receiving the updated gauge location map.

The level of Lake Tewaukon should again be held lower than the Master Development Plan elevation of 1149, to reduce bank erosion. The maximum level of 1148 recommanded by the manager should be satisfactory. However, if excessive bank sluffing occurs at this level, Lake Tewaukon should be lowered to reduce the erosion.

The matter of storing temporary floodwaters in Lake Tewaukon appears to be related to the problem of bank erosion also. We should not attempt to store floodwaters in Lake Tewaukon if they will cause severe bank erosion or contribute to excessive flooding of other refuge units. Lake Tewaukon and upstream pools do provide a limited amount of flood storage in the course of natural operations. However, the prime function of the refuge is not one of flood control and we should not attempt to gear operation primarily to that end.

We believe the best approach when dealing with flood operation proposals by local interests is to stress the fact that the prime refuge function is not flood control, but that some flood control benefits are inherent along with our operation. Figures (15) and (24) of the Master Development Plan illustrate this aspect quite clearly. Figure 15 shows that the normal annual runoff measured below the refuge may range in the 20,000 to 30,000 acre-feet category. (This checkswith 1965, 1966 and 1967 operation also.) Whereas Figure 24 shows how much storage is available on the refuge. For example, if we would limit fluctuation of refuge pools to only one foot, we could store only 3000 acre-feet on the refuge. Even if we could drain the refuge dry, we could only store 16000 acre-feet.

We are also limited on the refuge as to how high we can store water without causing damage to private lands. This is another prime concern in our operation. All these reasons should be stated in answer to any additional demands for flood control operation.

Specific reference is made to Photo #4 "panoramic view of pool 11 during high water in June" (elevation 1151.6±). should be 1152.7 The normal level for this pool is elevation 1151.0. At these levels private land owned by Harold Lee, Sargent County Commissioner, is flooded and the County road is inundated. It is our understanding that Mr. Lee is not interested in giving our Bureau a flowage easement. Neither does he wish to trade his acreage that is subject to flooding for cropland on the contiguous Tripp Tract now owned by the U.S. Government. He has suggested raising the County road and thereby blocking the flow from the pool through the road grade. This construction would also block the drainage from his land which may not be important to him, but still is important to us. We suggest that further efforts be made to effect a land exchange. If the land exchange can be arranged, the road could then be moved from the low area to the hillside.

It appears that there may be some discrepancy in acreage figures for several of the Tewaukon Pools (#2, #3, #8, and #12) as noted by the manager on page 4 of the program. We are not able to explain the differences observed, however some of the difference may arise because of the small scale of the photos and other factors too numerous to note here. With the exception of pool 3, we suggest that the Master Plan figures be used until the apparent discrepancy can be rectified.

John D. Umberger

Attachment
Pictures filed in Photo Binders
cc: Refuges--RO
RO Reading File

CWStephan:ce

Engr X

Regional Director, BSF&W, Mpls. 8, Minn. January 17, 1968

Refuge Manager, Tewaukon Refuge
Cayuga, North Dakota

Water Use (1967) and Water Management Plan (1968)

Impoundment data, outflow records for Lake Tewaukon, 1967 water use and the Annual Water Program for 1968 are attached.

Also enclosed is a letter sized refuge map showing the location of water gauges on pools.

The stream flow records of the U.S. Geological Survey for the Rutland and Cayuga gauging stations are included for your information and records.

We have also attached to the plan a copy of the report of vegetative transects which were run in 1967.

Along the line of preserving historical features, we are attempting to re-establish use of the name Heppe Lake for Clouds Lake. Local people use the name Heppe and want to see it retained. It is the Indian word for clouds.

We requested photos from the R.O. photo lab for inclusion in this report. When they are sent to us, we will prepare legends for them and send them in for insertion in this plan.

(Photos are filed in Tewaukon Picture file)

Herbert G. Troester

Attachments

ANNUAL WATER PROGRAM - TEWAUKON REFUGE

I. 1967 Water Use Data.

IMPOUNDMENT DATA

Pool 1, Lake Tewaukon for Calendar Year 1967
(flow line elevation 1140)

From Master Plan approximations

Month	Gauge Reading + (average)	Elevation (feet)	Area (acres)	Capacity (acre-feet)
Jan.	5.70*	1145.70	910	5,595
Feb.	5.70*	1145.70	910	5,595
Mar.	6.05	1146.05	969	5,932
Apr.	6.64	1146.64	1,055	6,550
May	6.56	1146.56	1,052	6,435
June	6.68	1146.68	1,058	6,625
July	6.66	1146.66	1,058	6,580
Aug.	6.04	1146.04	968	5,930
Sept.	5.43	1145.43	866	5,335
Oct.	5.28	1145.28	837	5,172
Nov.	5.35	1145.35	853	5,245
Dec.	5.45*	1145.45	869	5,355

Pool 2, Cutler Marsh for Calendar Year 1967
(flow line elevation 1144)

Month	Gauge Reading + (average)	Elevation (feet)	Area (acres)	Capacity (acre-feet)
Jan.	46.20*	1146.20	100**	
Feb.	46.20*	1146.20	100**	
Mar.	49.86	1149.86	241	615
Apr.	51.02	1151.02	260	780
May	49.80	1149.80	238	598
June	51.01	1151.01	258	778
July	50.23	1150.23	251	738
Aug.	49.29	1149.29	214	473
Sept.	48.69	1148.69	164	418
Oct.	48.46	1148.46	152	350
Nov.	46.83	1146.83	121	137
Dec.	45.42*	1145.42	50**	

Pool 3, Maka Pool for Calendar Year 1967
(flow line elevation 1148)

Month	Gauge Reading + (average)	Elevation (feet)	Area (acres)	Capacity (acre-feet)
Jan.	dry	-	24***	35***
Feb.	dry	-	24***	35***
Mar.	55.00	1155.00	118	495
Apr.	52.50	1152.50	105	220
May	52.06	1152.06	82	175
June	52.52	1152.52	106	222
July	51.89	1151.89	67	160
Aug.	50.39	1150.39	32	65
Sept.	48.69	1148.69	30	37
Oct.	48.35	1148.35	30	37
Nov.	50.58	1150.58	32	75
Dec.	51.40	1151.40	34	90

+ Outlet reading * Reading, top of ice ** Estimated *** Indian Slough

Pool 8, Heppe Lake for Calendar Year 1967
(flow line elevation 1174.50)

Month	Gauge Reading (average)	Elevation (feet)	Area (acres)	Capacity (acre-feet)
Jan.	6.23*	1176.23	123	502
Feb.	6.23*	1176.23	123	502
Mar.	6.30	1176.30	123	505
Apr.	6.50	1176.50	125	510
May	6.76	1176.76	128	543
June	7.53	1177.53	136	650
July	8.52	1178.52	146	786
Aug.	8.19	1178.19	142	743
Sept.	7.20	1177.20	132	603
Oct.	6.29	1176.29	123	504
Nov.	5.34	1175.34	113	490
Dec.	5.13*	1175.13	111	487

Pool 11, West White Lake for Calendar Year 1967
(flow line elevation 1145)

Month	Gauge Reading + (average)	Elevation (feet)	Area (acres)	Capacity (acre-feet)
Jan.	47.70*	1147.70	37	55
Feb.	47.70*	1147.70	37	55
Mar.	49.02	1149.02	57	115
Apr.	50.51	1150.51	72	215
May	50.29	1150.29	70	200
June	51.61	1151.61	88	300
July	50.92	1150.92	78	245
Aug.	49.33	1149.33	60	135
Sept.	48.70	1148.70	53	100
Oct.	48.46	1148.46	50	90
Nov.	48.14	1148.14	44	75
Dec.	48.00*	1148.00	42	72

Pool 12, East White Lake for Calendar Year 1967
(flow line elevation 1146.80)

Month	Gauge Reading + (average)	Elevation (feet)	Area (acres)	Capacity (acre-feet)
Jan.	47.70*	1147.70	101	370
Feb.	47.70*	1147.70	101	370
Mar.	48.53	1148.53	103	457
Apr.	50.00	1150.00	103	605
May	49.77	1149.77	103	580
June	50.73	1150.73	103	683
July	50.63	1150.63	103	672
Aug.	49.31	1149.31	103	525
Sept.	48.70	1148.70	103	475
Oct.	48.46	1148.46	103	450
Nov.	47.94	1147.94	102	396
Dec.	47.80*	1147.80	101	380

* Reading taken on top of ice. + Outlet reading.

Pool 13, Mann Lake for Calendar Year 1967

Month	Gauge Reading (average)	Elevation (feet)	Area (acres)	Capacity (acre-feet)
Jan.	8.48*	1208.48	45	178
Feb.	8.48*	1208.48	45	178
Mar.	11.48	1211.48	55	394
Apr.	10.39	1210.39	54	271
May	10.31	1210.31	54	266
June	10.87	1210.87	54	367
July	10.17	1210.17	53	259
Aug.	8.92	1208.92	47	198
Sept.	8.32	1208.32	45	171
Oct.	8.11	1208.11	43	163
Nov.	7.94	1207.94	42	155
Dec.	7.85*	1207.85	41	151

Pool 14, Sprague Lake for Calendar Year 1967

Month	Gauge Reading + (average)	Elevation (feet)	Area (acres)	Capacity (acre-feet)
Jan.	5.80*	1211.80	178	1,020
Feb.	5.80*	1211.80	178	1,020
Mar.	6.94	1212.94	187	1,190
Apr.	6.26	1212.26	180	1,087
May	6.24	1212.24	180	1,083
June	6.66	1212.66	185	1,150
July	6.08	1212.08	180	1,060
Aug.	5.52	1211.52	176	980
Sept.	5.00	1211.00	172	925
Oct.	4.68	1210.68	168	893
Nov.	4.58	1210.58	167	889
Dec.	4.50*	1210.50	167	887

Small Impoundments, 1967
(Clouds Lake drainage, average monthly readings)

Month	Pool 2A	Pool 3A	Pool 5	Pool 6	Pool 7	Pool 7A
Jan.	**1151.70	dry	*1162.73	*1167.00	Part. Filled	dry
Feb.	**1151.70	dry	*1162.73	*1167.00	Part. Filled	dry
Mar.	**1152.00	1154.10	1162.48	x dry	1169.70	dry
Apr.	**1151.77	1154.85	1162.57	x dry	1171.53	dry
May	**1151.32	1154.95	1162.77	1167.22	1172.58	dry
June	**1151.57	1153.70	1162.69	1167.20	1172.69	dry
July	1152.23	1152.27	1162.51	1167.36	1172.19	dry
August	1152.08	1151.60	1161.88	1166.62	1171.78	dry
Sept.	1151.57	1155.10	1161.72	1166.67	1171.64	dry
Oct.	1151.16	1155.05	1162.75	1168.11	1171.65	1176.18
Nov.	1151.00	1153.28	1161.23	1167.52	1170.18	1175.90
Dec.	(1)dry	*1151.40	dry	*1167.45	*1169.00	dry

*Gauge Reading, top of ice. **Estimated. +All months are 0.0 on gauge 1206.00
x Structure leaked dry - repaired. (1) Dry near gauge, some water in pool.

Table 24	Elev.	Acres	Table below * (Acres) 1074	Ave August Elev. (mean)
Pool 1	1149	1270		1146.04
2	1152	280	260	1149.3
3	1152	132	137	1150.4
4	1159	108		
5	1160	12	10	1161.9
6	1165	4	6	1166.6
7	1178	127	16	1171.8
8	1179	150	106	1178
9	1167	10	10	
10	1173	9	5.5	
11	1151	80	60	1149.3
12	1147	115	103	1149.3
13	1207	43	57	1208.9
14	1209	165	190	1211.5
15	1210	60		
16	1209	352		
Deep Bay	1149	80		

Tewaukon Refuge, Consumptive Water Use For 1967

Pool	A Avg. Annual Evap.	B 1967 Lake Rise	C Net Gain A+B	D * Surface Acres	E Ac-Ft Gain CxD	F Outflow in Ac-Ft	G Total Inflow Ac-Ft E+F
Sprague Lake #14	2.65'	-1.30	1.35	190.0	256	None	256
Mann Lake #13	2.65'	-.63	2.02	57.0	115	"	115
Pool 12	2.65'	.10	2.75	103.0	283	"	283
Pool 11	2.65'	.30	2.95	60.0	177	"	177
Pool 10	2.65'	.00	2.65	5.5	15	"	15
Pool 9	2.65'	.00	2.65	10.0	27	"	27
Heppe Lake (8)	2.65'	-1.10	1.55	106.0	164	"	164
Pool 7	2.65'	1.50	4.15	16.0	66	"	66
Pool 6	2.65'	.45	3.10	6.0	19	"	19
Pool 5	2.65'	.0	2.65	10.0	27	"	27
Pool 4	2.65'	-	-	-	-	-	-
Pool 3	2.65'	2.40	5.05	125.0	630	"	630
Pool 3A	2.65'	.80	3.45	12.0	41	"	41
Pool 2	2.65'	-.78	1.87	233.0	436	"	436
Pool 2A	2.65'	-1.00	1.65	27.0	45	"	45
Lake Tewaukon	2.65'	-.26	2.39	1,074.0	2,568	24,800	27,368
Total:						24,800	29,669

4,869 acre-feet consumptive water use in 1967.

* These acreage figures were planimetered from August, 1967 aerial photos taken by Winship. They are quite exact and Table 24 on Page 35 of the Master Plan should be amended accordingly. Our acreage for Lake Tewaukon does not include North Bay, though the Master Plan figure of 1270 acres does.

The acre-feet in Table 24 will also need revision. Our acre-feet calculations on Pools 12 and 8 were planimetered from contours drawn on the aerial photos and should be very accurate. The contours on the other pools are less well defined but have been calculated as accurately as possible. Pool 3 may need revision.

Compiled

Outflow Data, 1967, In C.F.S.

Lake Tewaukon Structure

Date	March	April	May	June	July	Aug.	Sept.
1	None	*50.1	*160.9	21.2	151.5	*47.9	6.4
2	"	63.2	147.0	21.2	151.5	41.0	6.4
3	"	*76.4	147.0	21.2	*151.5	41.0	6.4
4	"	70.3	147.0	21.2	145.0	41.0	6.4
5	"	70.3	147.0	*12.6	145.0	41.0	*4.5
6	"	70.3	147.0	13.9	145.0	41.0	3.0
7	"	70.3	147.0	13.9	145.0	*34.2	3.0
8	"	70.3	*133.1	13.9	145.0	30.9	3.0
9	"	70.3	104.7	13.9	145.0	30.9	3.0
10	"	*64.2	104.7	13.9	*138.6	30.9	3.0
11	"	70.3	104.7	13.9	123.0	30.9	3.0
12	"	70.3	104.7	*15.2	123.0	30.9	*1.6
13	"	70.3	104.7	140.6	123.0	30.9	None
14	"	70.3	104.7	140.6	123.0	*27.6	"
15	"	70.3	*76.4	140.6	123.0	25.4	"
16	"	70.3	66.4	140.6	123.0	25.4	"
17	"	70.3	66.4	*266.0	*107.5	25.4	"
18	"	70.3	66.4	243.9	91.9	25.4	"
19	*8.3	*76.4	66.4	243.9	91.9	25.4	"
20	21.2	96.1	66.4	243.9	91.9	25.4	"
21	21.2	96.1	66.4	243.9	91.9	*23.3	"
22	21.2	96.1	*56.4	243.9	91.9	15.8	"
23	21.2	96.1	43.1	243.9	91.9	15.8	"
24	21.2	*115.9	43.1	243.9	*76.4	15.8	"
25	21.2	*131.4	43.1	243.9	62.1	15.8	"
26	21.2	132.2	43.1	*221.8	62.1	15.8	"
27	*34.2	*133.1	43.1	186.6	62.1	15.8	"
28	42.1	147.0	43.1	186.6	62.1	15.8	"
29	42.1	147.0	*29.9	186.6	62.1	*8.3	"
30	42.1	147.0	21.2	*151.5	62.1	6.4	"
31	*50.1	-	21.2	-	*47.9	6.4	-
C.F.S. Total	367.3	2,556.4	2,666.3	3,908.7	3,356.9	807.5	49.7
Ac-Ft Total	728	5,069	5,287	7,751	6,657	1,601	99

C.F.S. Grand Total = 13,713 Ac-Ft Grand Total = 27,192 Compiled

*This is known data, all other figures are interpolations.

Measured stream flow at Cayuga was 24,800 acre-feet. The calculated discharge of 27,192 acre-feet at Lake Tewaukon was higher than the actual flow due to the carp barriers retarding the flow. ✓

USGS Provisional Rating @ Portland = 11300 Ac-Ft
" " " @ Cayuga = 24800 "

Tewaukon

	Total Mileage	Contrib D.A.
	(540 Mi.)	346
	(955)	565
	(661)	402

Classes

SUMMARY OF 1967 WATER PROGRAM

Spring Runn-off

Heppe Lake Watershed

High winds and warm temperatures sparked an early run-off during the last week of February. The temperature soon turned colder and it was not until mid-March that the major run-off began. Lack of any appreciable amount of snow on the ground helped to lessen the run-off.

Water which normally would run to Heppe Lake from the T-2 watershed retention dam was diverted to White Lake this year so that the S.C.S. could seed and establish grass in the drainage ditch leading to Heppe Lake. For this reason no appreciable amount of water was received in Heppe Lake. The lake only rose about one-half foot during spring run-off.

Pool 7 filled to management levels with run-off from the local area and also from water passing through Pool 7A, on which the gate remained open so the pool would dry up for millet seeding later on. Pool 6 leaked dry during spring run-off due to poor compaction along the outlet tube. The tube was repacked and a cement collar poured around it during May. The pool was then filled with water from Heppe Lake. Water levels in Pool 5 remained relatively stable through the spring run-off. The gate on Pool 3A was kept closed until high water was threatening the dike, about 1.3' of water was allowed to pass through before the gate was closed 4 days later. Pool 2A remained about stable during spring run-off.

Wild Rice River Watershed

Due to hardly any snow cover on the ground and lack of precipitation in March, flow in the Wild Rice River was negligible during spring run-off. However, there was enough water to fill Pools 1,2 and 3 to their management elevations.

1967 Water Conditions

Heppe Lake Watershed

Water levels in Heppe Lake remained relatively stable at 1176.50 +- until June 13. Run-off from locally heavy rains after this date raised the level of the lake up to a high for the year of 1178.72 on July 10. With heavy precipitation ending at this time the lake level began to gradually recede due to evaporation. It was necessary to open the outlet control gate during September to replenish water levels in the downstream pools 7, 6, 5, and 3A.

The gate was again opened on October 6 to flood the millet grown in Pool 7A. The gate remained open and the two pools leveled off with each other. Later, Pool 7A was drawn down and some water from Heppe Lake was passed down to Lake Tewaukon to raise it for the winter. The gate was closed on November 20. At the end of the year the lake elevation is 1175.13.

Pool 7A was farmed and seeded to millet in the summer and then flooded in the fall to elevation 1176.26. All water was released in November for winter drawdown.

Pool 7 remained at or near management levels through the summer and fall. A release from Heppe Lake was made in September to replenish the lowered pool. It was put into winter drawdown in November, and was at 1169.00 at freeze-up.

Pool 6 leaked dry during spring run-off. The dike was repaired and raised about 1.5' during May. The pool was then filled with water released from Heppe Lake. Water was released from Heppe Lake in September to flood willows growing around the pool edge. During the summer beaver used the pool and made a cache near the dike. For this reason, Pool 6 was not drawn down for the winter and remains at 1167.45 at the time of this report.

Pool 5 water levels remained relatively constant at 1162.00 during the summer. 1.8' of water was run in the pool from Heppe Lake. The pool was drawn down in November and is dry at year's end.

Water was held in Pool 3A during the summer. Numerous fluctuations in water levels took place as this pool is the end outlet of actually five other pools, Heppe Lake, Pools 7A, 7, 6, and 5. The dike around this pool is used as one of our major traveled roads on the refuge. It was raised during the summer to the 1160 elevation. The same as the dike elevation on Pool 3. The pool was drawn down in late summer to remove carp that entered when the gate was open and to permit alfalfa to be seeded around the south shore.

The dike-road around Pool 2A was also raised to 1157 and widened during the summer. Water was allowed to enter the pool by backing it in from Pool 2 through narrow gaps in the stoplogs to exclude carp. The elevation held at +- 1152.00 throughout the summer. The pool was drawn down in late fall to send available water into Lake Tewaukon and to remove bullheads which had gained access to the pool.

White Lake Watershed

The above average precipitation received during early June through July 10 greatly affected the water levels of Pools 11 and 12, East and West White Lake.

Water coming in from T-2 plus local run-off could not be passed out of Pool 11 structure as fast as it came in. Due to these rising water levels we had to pull stoplogs from Pool 2, Cutler Marsh, so that water could flow out of Pool 12 to ease the rising Pool 11, West White Lake. West White Lake rose from 1150.80 on June 14 to 1152.70 (high reading for the year) on June 23. Dike elevation on Pool 11 is 1154.00. Some thought was given to opening the plug which diverted T-2 water into White Lake and have it run its normal course to Heppe Lake. But all concerned decided not to do this to spare the grass seeding.

The high water levels in Pool 11 flooded the county road to the south of the lake and also about 20 acres of private land. Water stayed over the road for eight days although was not deep enough to restrict travel. By the end of June things appeared to be slowly getting back to normal. At this time Pool 11 had dropped to 1151.83. By the end of July the pool read 1150.00. It was not until July 29 that flow from T-2 stopped. By the end of August we had reached management elevation of 1149.00 in Pool 11. Pool 12 also read 1149.00 at this time. The pools receded gradually through the remainder of the summer and were drawn down as far as possible in November and December to send water through Pool 2 for use in replenishing the level of Lake Tewaukon. Dam 11 was riprapped during the summer.

Wild Rice River Watershed

Mann Lake, directly connected with the Wild Rice River, fluctuates widely during the year. Heavy rains received in June put the lake elevation over out water gauge. The lake rose 2.7' in one week (1209.50 - 1212.20). The lake held at about 1209.00 and lower throughout most of the summer and at freeze-up read 1207.85.

Water levels on Sprague Lake held at 1212.00 before the heavy rains of June hit - then climbed to a high reading for the year, 1214.00 on June 15. At freeze-up the elevation is 1210.50. Some silt was received with flow from watershed dam T-1A but not as much as the previous year's.

Pool 4 structure was not operational until late fall. Since the river had stopped running before the dam was completed no water was held in the pool, except for a small amount in the channel which backed up from Pool 3 during the fall.

Pool 3 was to be managed at 1152.00 so that water would not affect the work on Pool 4 structure. The pool fluctuated widely with heavy June and July rains. This was the first year the structure was in operation and leakage took place in the 4 x 4" stoplogs. To completely dry up the pool, ammonium nitrate blasting was used to straighten and deepen the upstream channel to the structure. Additional water was added to the pool in November, through Pool 3A, to allow for muskrat use of the pool.

The entire 950' dike was riprapped during the summer by refuge personnel and seasonal laborers.

Management of Pool 2 was also quite difficult during the year. Stoplogs had to be removed on several occasions to lower the pool so that water could pass through Pool 12 for lowering Pool 11. Because of the heavy river flow during the June rains it was hard to lower this pool so that water could run out of Pool 12. After July rains ended the pool was held at 1149.00. It was lowered this fall for a fish kill and to raise low water levels in Lake Tewaukon. At freeze-up its elevation is 1145.42. Bank erosion was serious on the pool this spring with high water levels and strong southwesterly winds. The 400' dike was reinforced with riprap during the summer.

With the heavy precipitation received this summer Lake Tewaukon (Pool 1) rose almost 2 feet in a five day period, from 1145.85 to 1147.50, the high reading for the year. The pool was to be held at or below elevation 1146.00 to facilitate building of the boat ramp on the northwest end of the lake. The levels held close to this figure during the summer but with below normal precipitation and evaporation the elevation had dropped to 1145.25 on October 23, the low reading for the year. After this time water was released into Lake Tewaukon from upstream pools and at year's end the elevation is 1145.44. With this level we do not believe the lake will winter kill unless we receive above normal amounts of snow and severely cold weather. The lake is almost free of snow now. There was also open water on the lake in mid-December and at the end of the year about one foot of ice covers the lake.

Potholes

Water conditions remained excellent in the potholes through late August because of high precipitation. Water levels on most potholes was out of its normal basin until early August. Because of the cloud bursts received some potholes silted in considerably. Some off-refuge farmers, who had drained potholes during the drier month of May, found it necessary to plug these drains as high water levels went over roads due primarily to their drainage efforts. Water conditions deteriorated rapidly after August. At freeze-up the potholes have less water than last year. This is attributed to a warm, late fall and below normal rainfall since mid-August.

Food

Partially used millet and barley fields were available to spring migrants and the fields were well utilized.

Due to the cool, wet spring pond weed and emergent vegetation were slow in developing. With the warmer weather of June growth progressed at a rapid rate. Excellent stands of emergents were noted by mid-June.

Sago growth in Heppe Lake continued to flourish since carp eradication in 1965.

The millet grown in Pool 7A was well used by ducks and geese after flooding in October.

The larger carp-infested lakes were all but barren of vegetation and little use was noted on these areas except for watering and resting.

The hail storms that struck the area during June and July severely damaged the grain fields and also emergent marsh vegetation. The most severe hail storm hit on June 30. Coupled with 1" hail and 85 mph winds it literally pounded vegetation flat. For this reason, early seeded grains were heavily damaged.

Millet did quite well but had to be seeded late due to wet conditions.

Waterfowl Use

Because of the cool, wet spring and stormy wet summer, duck nesting conditions were far from ideal.

Undoubtedly many nesting attempts failed due to widely fluctuating water levels, hail storms and wet conditions. Broods were few and late in coming off the nest. Class IA broods were noted in early August as an example. Production was less than one-fourth of last year's.

Pool 7 was well used by the few broods available. It held water for the first time this year so was quite fertile with sub-mergents and water insects. Pool 7 also attracted good numbers of water-fowl during fall migration because of its close proximity to the flooded millet in Pool 7A.

As food was in short supplies on the refuge, except for green browse, both geese and ducks made extensive use of flooded millet in Pool 7A. Over 14,000 ducks and 6 to 8,000 geese quickly gleaned the millet from this 20 acre field.

Heppe Lake was well used by divers and also geese for resting and watering.

Sprague Lake received excellent use by ducks and geese which fed in the surrounding croplands.

1968 ANNUAL WATER PROGRAM

All control structures on the Tewaukon Unit called for in the Master Plan are now in place and operational. Dike 4 will require seeding and riprapping, and carp barriers will be necessary on several dams, but these items will not effect water management.

This year's plan has again incorporated the proposed S.C.S. diversion of the Heppe Lake watershed into White Lake (see discussion of Heppe Lake watershed).

The Water Program is described for the Tewaukon Unit and for the Sprague Lake Unit. The Tewaukon Unit is described according to water source: Wild Rice River, Direct; White Lake Watershed; and Heppe Lake Watershed.

Tewaukon Unit

I. Wild Rice River Watershed, Direct

Pool #4

This will be filled to 1159.0 at the end of the spring runoff. It should be maintained at a lower elevation until the peak flow is past to prevent flooding of private land should heavy rains suddenly increase the flow.

Carp should, if possible, be prevented from passing downstream from Sprague, Mann and Silver Lakes by the installation of a carp barrier. We are experimenting with several different types.

Pool 4 could be drawn down entirely for the winter to prevent fish carry-over and to provide water for Lake Tewaukon if that be necessary. Otherwise it could be maintained at a slightly lowered winter level.

How Pool 4 will affect goose distribution on the refuge may also be a factor in its management. Should the geese chose to loaf on Pool 4 and thereby be more vulnerable to hunting on Mel Breker's and Roy Clarum's commercial pit areas, we might want to drain the pool during hunting season. We do not expect this to happen, though.

Pool 3A

We can hold this at 1156.0. Alfalfa nesting cover planted along the south shore in August, 1967 should increase nesting adjacent to this pool.

Pool 3A (cont.)

Pair counts should be made of the shoreline and records of brood use kept.

There should be no carp in this pool, but should it be necessary to dewater it into Pool 3, the outlet tube should be screened against carp.

Pool 3A can be lowered some for the winter to prevent muskrats from burrowing into the dike, but it will not be necessary to dewater it completely.

Pool 3

This pool will be held below 1156.0 until the peak of spring run-off is past, then will be held at 1156.0 for the summer.

The bridge over the township road on the west end of Pool 3 is not much above 1156.0, so it will be necessary to provide for passage of run-off water without raising the water up to the bridge.

The loafing islands dug on the southwest shore of Pool 3 will be evaluated for pair use during the spring. A similar length of shoreline on the north side of the pool could be censused to check on its comparative pair use.

Alfalfa nesting cover was seeded in August, 1967 along the southwest shoreline so we would expect that part of the pool to be very attractive to nesting ducks.

The pool should be drawn down for the winter to provide water for Lake Tewaukon, to eliminate any fish life, and to provide storage for spring run-off.

Pool 2A

This pool will be flooded from carp-free water coming from Heppe Lake through Pool 3A. We can hold it to elevation 1154.0.

Alfalfa nesting cover was planted on the south and west sides of this pool in August, 1967. We will make a careful pair count of this shoreline and will also expect to see increased brood use due to some new flooding here.

The pool can be drained for the winter or drawn down to about 1152.0 for muskrat carry-over. The decision would depend on the presence or absence of bullheads. At any event, the pool should not be against the dike sideslopes to prevent muskrat burrowing there.

Pool 2A (cont.)

If the pool is to be lowered for the winter it should be lowered about September first to mid-September. This might enhance bait trapping of teal for banding, but should be done before muskrats begin building houses.

Pool 2

This is a management problem. The Master Plan calls for an elevation of 1152.0, yet all the water that comes into White Lake from the T-2 Reservoir has to be discharged through Cutler's Marsh. We cannot hold Pool 11, West White Lake, much higher than 1150.0 without flooding private land. So we have to pass excess water into Pool 12, White Lake, and once that has filled up the water has to go into Cutler's Marsh.

Therefore, Cutler's Marsh has to be held below 1150.0 until run-off from T-2 is complete, after which if water is still available in the Wild Rice River the pool could be raised.

Even after run-off has passed, the 10 square mile drainage area that is diverted into White Lake can cause flooding due to heavy rain, as it did in 1967. Should this happen again, we would expect to divert the T-2 flow to Heppe Lake, so the threat of flooding is not without solution.

Pool 2 will need a carp barrier on it.

The pool should be drawn down for the winter to effect a fish kill and raise the level of Lake Tewaukon. The two pools will equalize, hopefully at about 1148.0 to 1149.0.

Pool 1

Now that the boat ramp has been built, the Master Plan calls for an elevation of 1149.0 in Tewaukon to "enhance the recreational aspects of the lake and to lessen the possibility of the Lake going dry during periods of extreme drought".

This higher water will cause accelerated bank erosion. The erosion would be serious and the resultant murky water might actually be detrimental to sport fishing and swimming.

It is our opinion that a lower elevation, about 1148.0, would be adequate for recreation. This level would be near the top of the natural riprap which is found on all banks. This riprap has resulted from rocks in the glacial till being washed into the lake by bank erosion and then being piled along the shores by ice heaving.

Pool 1 (cont.)

Probably the main need for deeper water is to increase the chances of fish survival during the winter. Accordingly, Tewaukon could be raised prior to freeze-up by release of water from upstream pools. The winter level would be as high as summer levels (refilled after evapo-transpiration) or even higher. Ice heaving might be a factor in bank erosion but we believe it would be less than wave erosion.

Lake Tewaukon was popular as a fishing lake before any structure was built on the lake. After it went dry in 1934, a rubble masonry dam was built with a spillway elevation of 1147.0. Yet in all this time there have been only about three winter kills of fish in Tewaukon.

One of these occurred in the winter of 1947-48 when the level of the Lake was 1.5' below the spillway, or at elevation 1145.5. Another occurred in 1951-52, a year of very heavy snow. Fish survived during all other years with the lake below level 1147.0. Oxygen content of Lake Tewaukon is usually very high as a result of high diatom and algae populations. In fact, on March 10, 1954, Bob Sharp tested the oxygen content at 43.4 ppm, far above saturation.

An oxygen test made during 1966-67 at elevation 1145.70 was high, but we do not have it recorded.

The question of temporary storage of flood water in Tewaukon was posed this summer. Several people asked why we couldn't store flood water and then release it slowly during the summer. They felt this would be beneficial to downstream farmers by lessening flooding and then later providing a river flow for cattle watering during late summer when there usually is no flow.

At the time we were getting all this river flow, we could not very well have stored it because we did not know how much more was coming.

This is a good question, though. If our carp barrier can be made so that stoplogs can easily be added or removed, should we attempt to store and then slowly release a part of flood-water? We would appreciate Regional Office response to this question so we will know how to answer our neighbors should they ask again.

We are not in the flood control business

II. White Lake Watershed

Spring run-off from the Heppe Lake watershed will be diverted into the White Lake watershed by the Soil Conservation Service.

II. White Lake Watershed (cont.)

This diversion will allow the establishment of grasses in the newly excavated channel from their T-2 reservoir into Heppe Lake. If excessive run-off occurs, which may cause damage in the White Lake watershed, the temporary diversion dike at T-2 will be excavated to pass this excess water into Heppe Lake. Water will be allowed to pass into Heppe Lake only when it appears that Pool 11 would go over the 1150' elevation.

Pool 11

Pool 11 is presently at 1148.0 elevation. Carp are present and we expect a winter kill again, just as last winter when the pool was at 1147.7.

We will keep the stoplogs low in the structure during spring run-off, but maintain a carp barrier if possible. When run-off is nearly complete, we will install stoplogs to 1149'. Should heavy or prolonged rains occur, the pool should be lowered in anticipation of flooding by draining it into Pool 12 and that into Pool 2 and that into Lake Tewaukon.

If the threat of heavy rains is great enough, the T-2 drainage will be diverted into Heppe Lake. In that case, it probably would not be necessary to dump Pools 2 and 12.

Winter management will depend on the status of the T-2 drainage. If it is to go to Heppe Lake, Pool 11 should be maintained at its normal elevation of 1149.0, because run-off would be considerably less the following spring. If T-2 should again be diverted to White Lake, then Pool 11 should be drawn as low as it will go.

Pool 12

The present elevation is 1147.80. At the end of December, there was 1.0' of ice and a total water depth of 5.0'.

Stoplogs will remain out of the structure for as long as Pool 12 can be lowered with water yet available to fill Pool 2. The logs should then be replaced and Pool 2 raised. A carp barrier will have to be built on Dam 12. Pool 12 should be held just as low as we can get it. If fish do not winter kill, and an effective carp screen can be devised, the fish there should be chemically removed during the summer. The lake is absolutely barren and worthless as it is.

It will not be possible to lower Pool 12 below the level of Cutlers Marsh, and if Lake Tewaukon raises to that level, drawdown is ended.

Pumping Pool 12 down is a possibility, but only as a last resort.

III. Heppe Lake Watershed

If T-2 discharge is diverted into Heppe Lake, we will have to discharge water from it. If not, we will have only local run-off to contend with. This may or may not make discharge necessary. In 1967, we received only 0.6' of run-off in Heppe Lake into May, but then 2.0' in June and July.

Pool 7 will need about 50 acre-feet to fill it and Pool 5 30 acre-feet. This will take about 0.8' of water from Heppe Lake at the most. If Pools 3A and 2A are also filled, another 35 acre-feet and 75 acre-feet will be needed, respectively. These are maximum amounts and much less might do the job. About 1.9' of water from Heppe Lake would be the maximum needed. The flow line is 1174.5, so no more than 0.5' is available as of right now.

Pool 3A can be filled from Pool 3 and so can Pool 2A or Pool 2A can be filled from Pool 2. So it would appear that we have adequate water in Heppe Lake at the present.

This leaves no water for field flooding, and 0.3' was used in 1967. This is the least important use of our water, though.

Heppe Lake was a great production lake in the early 40's at about 1175.0 elevation or lower. We prefer to hold it at this level, even if field flooding is not possible.

This field flooding is not essential for goose management, but can be a useful duck depredation abatement measure.

Pool 10

Water will be supplied from Heppe Lake to this pool if necessary.

Pool 9

Water will also be supplied from Heppe Lake to this pool if necessary.

Pool 7A

The gate on this pool will remain open during spring run-off so that all water in the local area may flow through Pool 7A into Pool 7.

Millet will be seeded in this pool during the summer and if water from Heppe Lake is available it will be flooded during early October to ease duck depredations on private land.

The pool will be drawn down in November.

Pool 7

The pool is presently at 1169.0' elevation.

It will be managed at 1172.0' during the summer. With local run-off from Pool 7A and from that received in the watershed of Pool 7, we believe we will get the additional 3' of water necessary to fill the pool. In this case releases from Heppe Lake would not be necessary.

Pool 6

The pool is presently at 1167.45.

Water will be held at this elevation or higher during the year to flood cattail and willow growth in the upper end of the pool.

There will probably be no reason to draw this pool down for the winter, though it could be lowered some.

Pool 5

Pool 5 is presently drawn down for the winter.

It will be maintained at elevation 1162.5'. Water should be available from spring flows through upstream Pools 7A, 7 and 6 to fill this pool to management elevations.

It will probably not be necessary to draw this pool down for the winter.

SPRAGUE LAKE UNIT

Sprague Lake

As there are no water controls on this lake management of the water level is not possible.

If water in Sprague Lake reaches high levels water can be diverted into the marshes to the west and south of the lake, with carp screening.

Mann Lake

This lake is directly connected to the Wild Rice River and no water controls are available for regulating lake elevations. No management of water levels will be possible in 1968.

January 16, 1968 Herbert G. Troester H.G.T.

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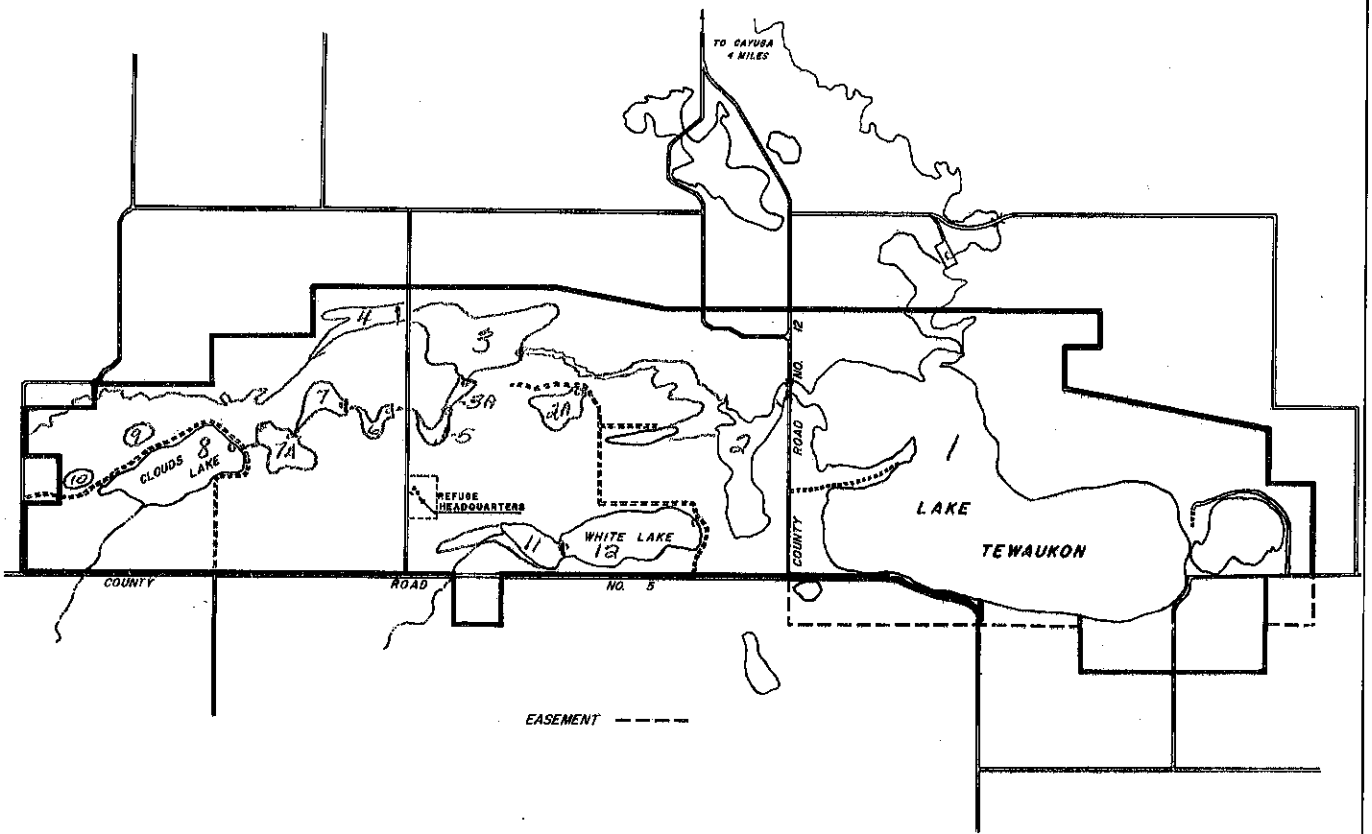
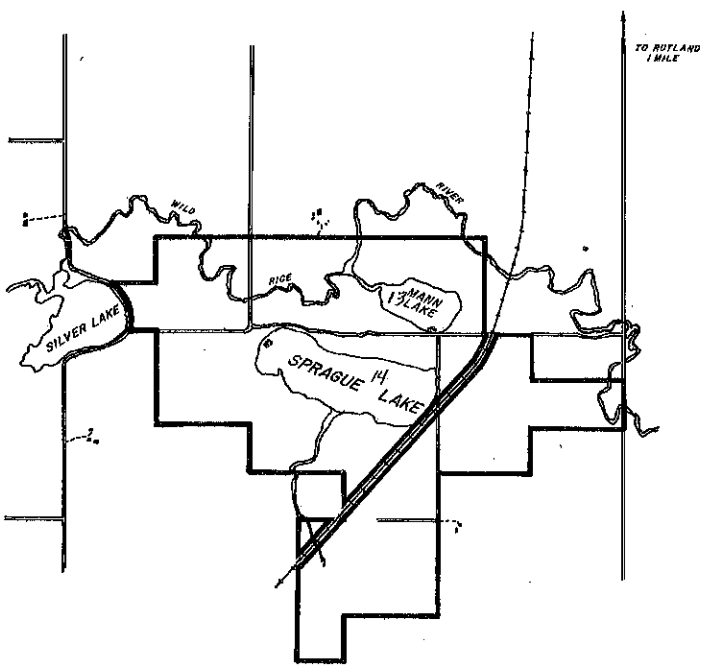


SPRAGUE LAKE DIVISION



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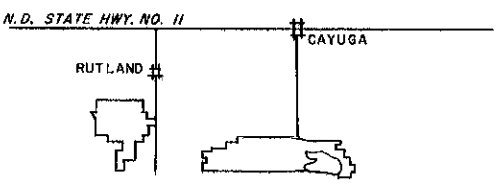

1967 Easement Refuge Water Use - Tewaukon District

The steel post water gauge which was installed last winter on the Bonehill National Wildlife Refuge was destroyed this past spring by ice action. Some type of gauge should be devised and installed here for accurate water readings. At present, we have to estimate how far the water is below the sod spillway.

Water was present in the 93 acre marsh on the Maple River National Wildlife Refuge, although the old rubble structure in the river was ineffective (structure replaced in fall of 1967 - see photos). Silt has accumulated in the outlet ditch of this marsh, retaining the water. The small rubble structure (see photo) in the ditch is largely ineffective. However, at present we are not sure of the management significance of this small structure - the old Bureau of Biological Survey topog map shows the flow-line at 1391' (crest of new dam) but the new topog survey (1967) shows the flow-line at 1389.2'. In the latter case, about two feet of water will be present at this structure and continue back into the large marsh. This level may be adequate in the future, and thus not require repairs to this structure.

Lake Elsie National Wildlife Refuge had the highest water level on record this past summer. Heavy rains and the development of five springs accounted for this. The lake water rose up over the bank on the east side and increased the water in the existing adjacent marsh. This increased water in the marsh threatened to overflow the township road, which didn't have a culvert. The township subsequently installed a 24" culvert and raised portions of the road. Surplus water was therefore diverted to Grass Lake. A sandbag spillway has been installed at the overflow location on Lake Elsie by the Hankinson Sportsmen's Club.

Water levels at Storm Lake National Wildlife Refuge were about normal for the year.

The Wild Rice River National Wildlife Refuge does not have a dam to retain water and is of questionable value for waterfowl.

Easement Refuges, Consumptive Water Use For 1967

Refuge	A Ave. Annual Evap.		B 1967 Lake Rise	C Net Gain A+B	D Surface Acres	E* Ac-Ft Gain C×D	F Outflow in Ac-Ft	G Total Inflow Ac-Ft E+F
Bonehill	2.65'	(1)	-1.90	.75'	40	30	Unk.	Unk.
Lake Elsie	2.65'	(2)	- .67	1.98'	317	628	None	
Maple River	2.65'		Unk.	2.65'	93	246	Unk.	Unk.
Storm Lake	2.65'	(3)	- .46	2.19'	181	396	Unk.	Unk.
Wild Rice	2.65'		Unk.	2.65'	(4) 3	8	24,800	24,800

*Water use.

(1) Water 2.1' below spillway 12-9-66. Water filled to spillway level in spring, then evaporated and seeped to estimated 4.0' below spillway, 12-13-67.

(2) Water 18½" below first "I" beam on NW corner of road bridge on 12-8-66; 26½" below on 11-1-67.

(3) Water 54½" below peak of south angular wingwall on west side of road bridge on 10-10-66; 60" below on 11-29-67.

(4) Beaver impoundment.

Physical Condition of Control Structures

Bonehill Refuge, LaMoure County

Good condition. See photos in 1966 report.

Lake Elsie Refuge, Richland County

Natural Lake basin without outlets or water control.

Maple River Refuge, Dickey County

New dam installed in river channel in 1967 (see photos). Small structure in ditch is largely ineffective and in poor condition (see photos).

Storm Lake Refuge, Sargent County

Control structure ineffective, but in fair condition (slide gate is removed). See photos in 1966 report.

Wild Rice River Refuge, Sargent County

Beaver dam only.

January 16, 1968

R.E.E.

THE 1967 AQUATIC VEGETATION SURVEY

Introduction

The transects involved in the 1967 Aquatic Vegetation Survey were run on August 7, 8, 14, and 15, when the plants could be most easily identified. In general, guidelines provided by previous reports from this refuge were followed and the suggestion that empty half-gallon plastic jugs be attached at station markers was attempted in some areas and found to be a practical solution in helping to eliminate fouling of the wire by algae and other vegetation.

THE INDIVIDUAL TRANSECTS

Cutlers Marsh #1 - water elevation 1149.21'. Avg. depth 4'. 8-14-67.

With the exception of several beds of Coontail (Ceratophyllum demersum) no vegetation was observed along the transect line. Both the start and finish shorelines contained narrow bands of mixed bulrushs (S. fluviatilis, S. acutis); the start end of the transect also contained a few bands of narrow leaved cattail (T. augustifolia).

Cutlers Marsh #2 - water elevation 1149.21'. Avg. depth 3'. 8-14-67.

First half of transect (stations 1-7) dominated by dense stands of live and dead cattail (T. angustifolia). Open water areas contained sparse patches of sago pondweed (P. pectinatus). High water evidently caused a large die-off of much vegetation. Primarily Typha on this transect. Water was cloudy and heavy carp activity was observed.

Cutlers Marsh #3 - water elevation 1149.21'. Avg. depth 1'. 8-8-67.

Entire transect dominated by dense stands of cattail (T. angustifolia). Also, a heavy die-off of cattail occurred leaving much decayed organic matter. Water was quite cloudy and received heavy carp use.

White Lake #1 - water elevation 1149.10'. Avg. depth 7'. 8-13-67.

No vegetation observed on entire tract. At most stations water was too deep to reach bottom. Water was quite cloudy and some carp activity was observed along the shoreline.

White Lake #2 - water elevation 1149.40'. Avg. depth 3' & then 1'. 8-8-67.

Transect line characterized by sporatic observations of a varying number of aquatic plants. Representatives of most common aquatic plants were observed but in small numbers. There was a large water kill of Typha on the South end due to varying water levels. Water was cloudy and there was moderate carp activity.

Pool #5 - water elevation 1162.00'. Avg. depth 18" (36" & 48",too). 8-8-67.

Pool 5, as reported in previous years, had a lush and varied growth of aquatics....Star duckweed (Lemna trisulca), and sago pondweed (Potamogeton pectinatus) being dominant in open water, with large stands of Typha angustifolia and Typha latifolia at the west end of the pool. Water was clear because of the absence of carp and the area was generally ideal duck marsh.

Pool #6 - water elevation 1166.70'. Avg. depth 21". 8-7-67.

Extremely lush growth of aquatic vegetation observed in this pool. Dominant species - Sago pondweed (P. pectinatus). Also observed specimens of Sagitteria. Dense stands of Typha ring the pool to a 30' width. Water clear.

Clouds Lake - water elevation 1178.14'. Avg. depth 8'+. 8-15-67.

A lack of aquatic vegetation in Clouds Lake usable by waterfowl populations was thought to be a result of previous high carp populations before the lake was rotenoned in 1965. Since the carp control program, in August of that year, aquatic plants have been on the rise. In 1965 only scattered beds of Scirpus acutis and Scirpus americanus were seen along the edge of the lake. In last years, beds of Potamogeton pectinatus 3-6' in diameter were seen along the shore. This year, a 12' band of Scirpus acutis and Scirpus americanus was seen along much of the south and east shores of the lake, an 8' band of sago pondweed (Potamogeton pectinatus) was observed along most of the shoreline; large patches of sago were found all along the transect route; small patches of Scirpus richardsonii were found along the north shore; the lake was full of floating and small quantities of filamentous algae.

Pool #9 - Avg. depth 4'. 8-8-67.

Entire pool void of vegetation with the exception of a narrow band of shoreline which contained mixed duckweed (L. trisulca and L. minor). A few isolated patches of coontail (C. demersum) were also observed in this band. Water cloudy.

Pool 10 - Avg. depth 4'. 8-8-67.

Entire pool void of vegetation. Bottom covered with filamentous algae. Pool feed by an artesian well which may account for lack of vegetation. Water cloudy.

M - Vegetative Transects

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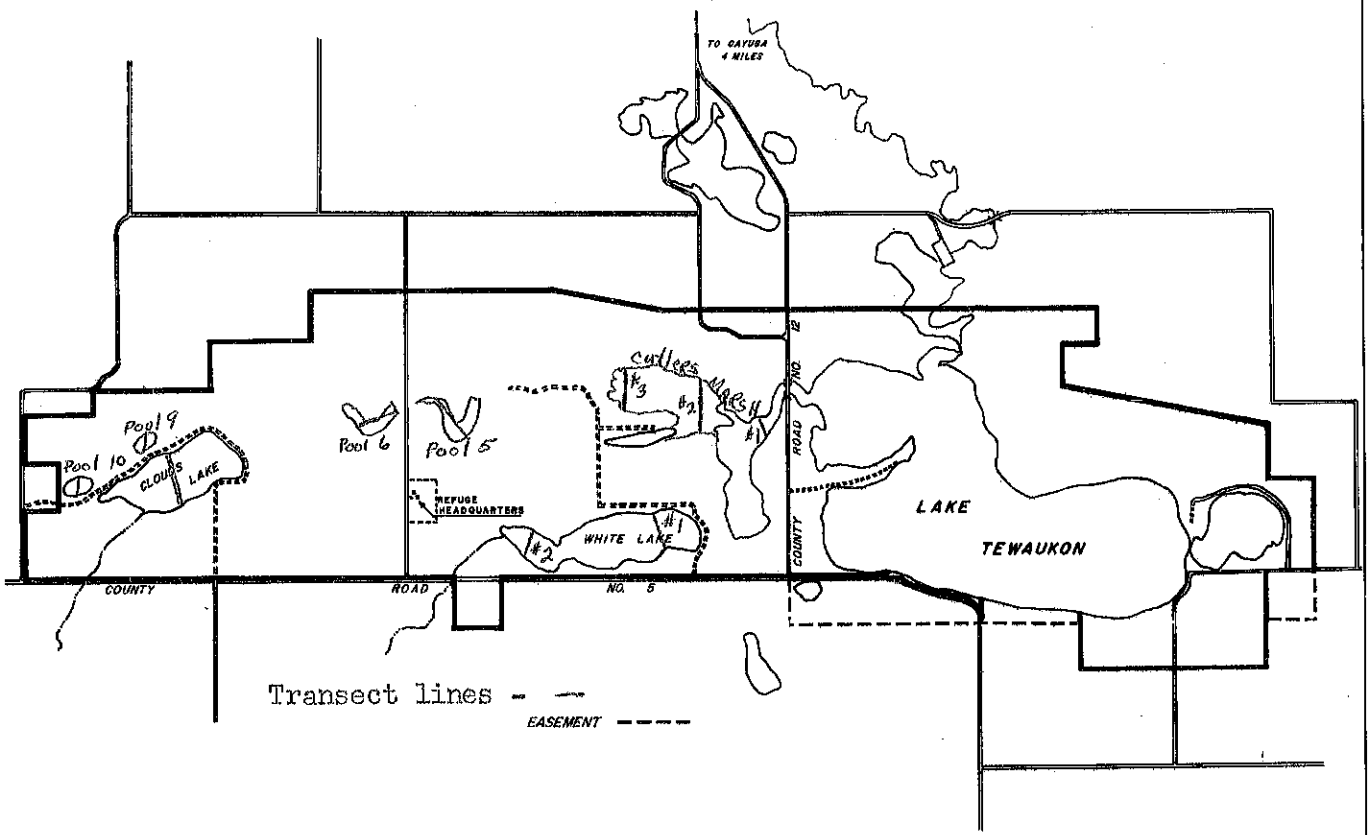

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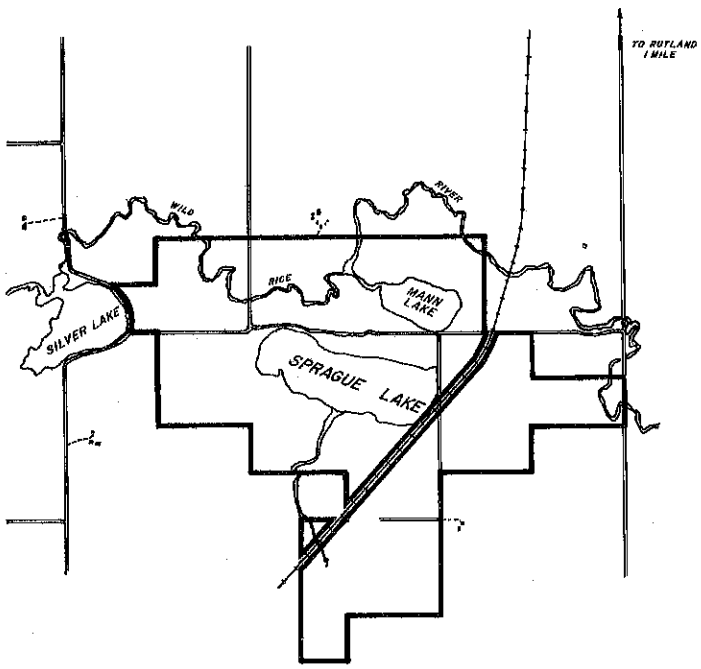

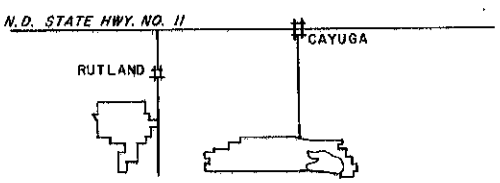

Photo #1 - High water levels and strong southwesterly winds caused severe bank erosion on Dike 2 during the spring.

Photo #2 - Riprapping in progress on Dike 2 during late May. Dikes 3 and 11 were also riprapped during the summer using most of the rock piles available in areas adjacent to the dikes.